

MECHANIX ILLUSTRATED

THE HOW-TO-DO MAGAZINE

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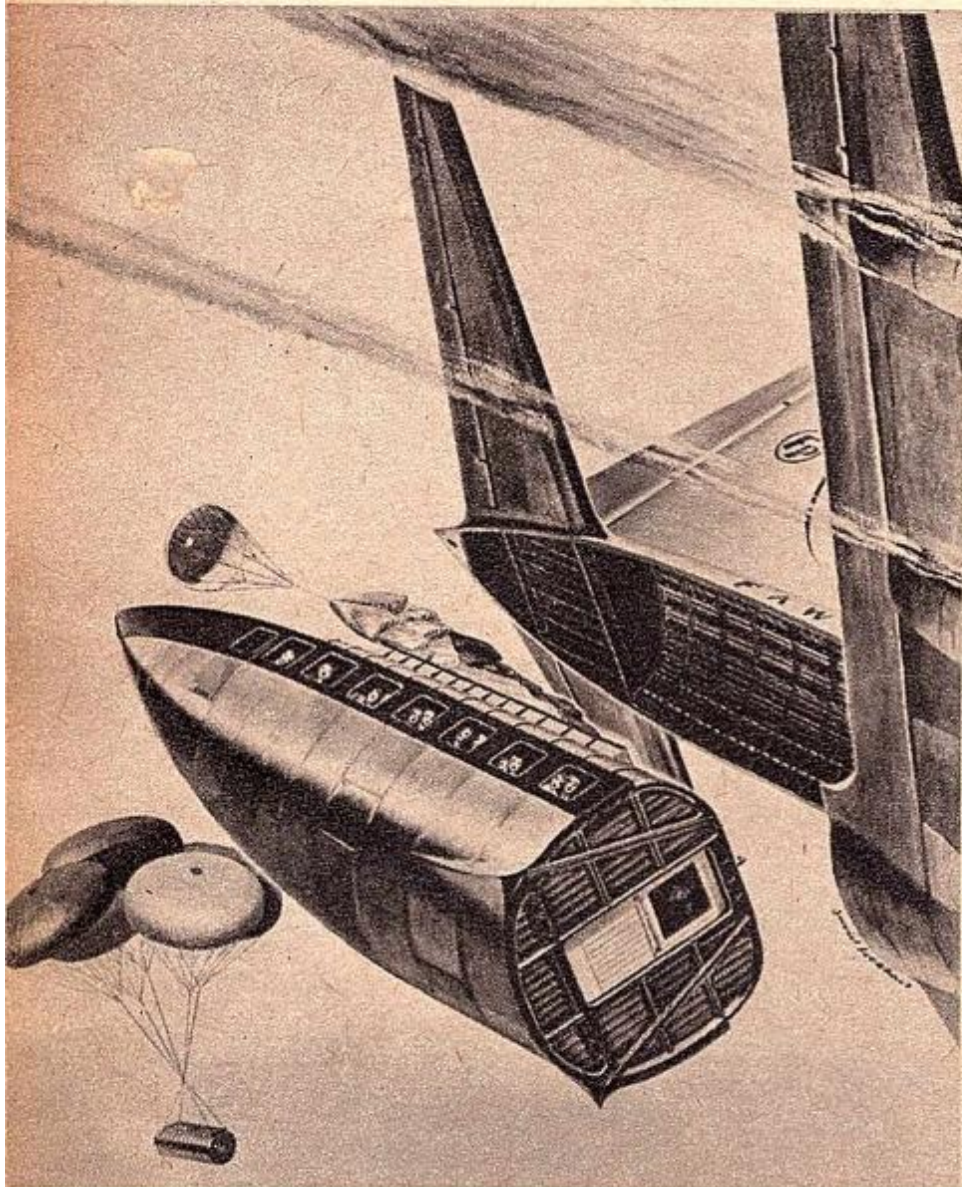


**ESCAPE CHUTES CAN CUT
OUR AIRLINE DEATH TOLL!**

**Механикс Иллюстрейтед
новое лучшее том 1**

**AIR-CRASH
VICTIMS
NEED NOT
DIE!**

TURN PAGE...



ESCAPE PODS CAN PREVENT NEEDLESS AIR-CRASH DEATHS!

By Robert G. Beason

EJECTION of pod is triggered by crew member inside it. Bulkhead and door are airtight.

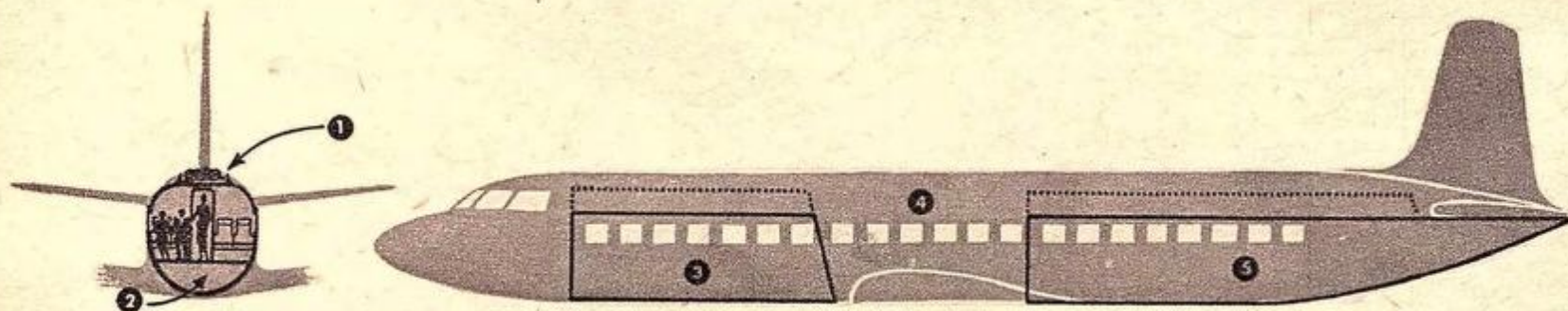
DECEMBER 22, 1959: Twenty-five passengers and six crew members on a Brazilian airliner are killed after their plane is rammed by an Air Force trainer over Rio de Janeiro. There is just one survivor—the military pilot.

The story of the tragedy was familiar. Three times in as many years commercial planes carried all aboard to death after such mid-air collisions. In each case one person survived—the military flier who parachuted to safety from his crippled

plane after the crash occurred.

A box score for the four crashes shows: Airliners—77 killed. Military planes—4 saved.

In 1959 we recorded the worst airline safety record in history, with more accidents and more fatalities than ever before. Today the special horror of mid-air collision, no longer a freak, is a major danger to every air traveler from hotshot jet jockey to the tired salesman returning home.



1. PARACHUTE RACK atop pod. 2. Belly compartment holds freight, ballast weights, pneumatic shock absorbers. 3. Forward pod. 4. Galley, washroom, luggage. 5. After pod.

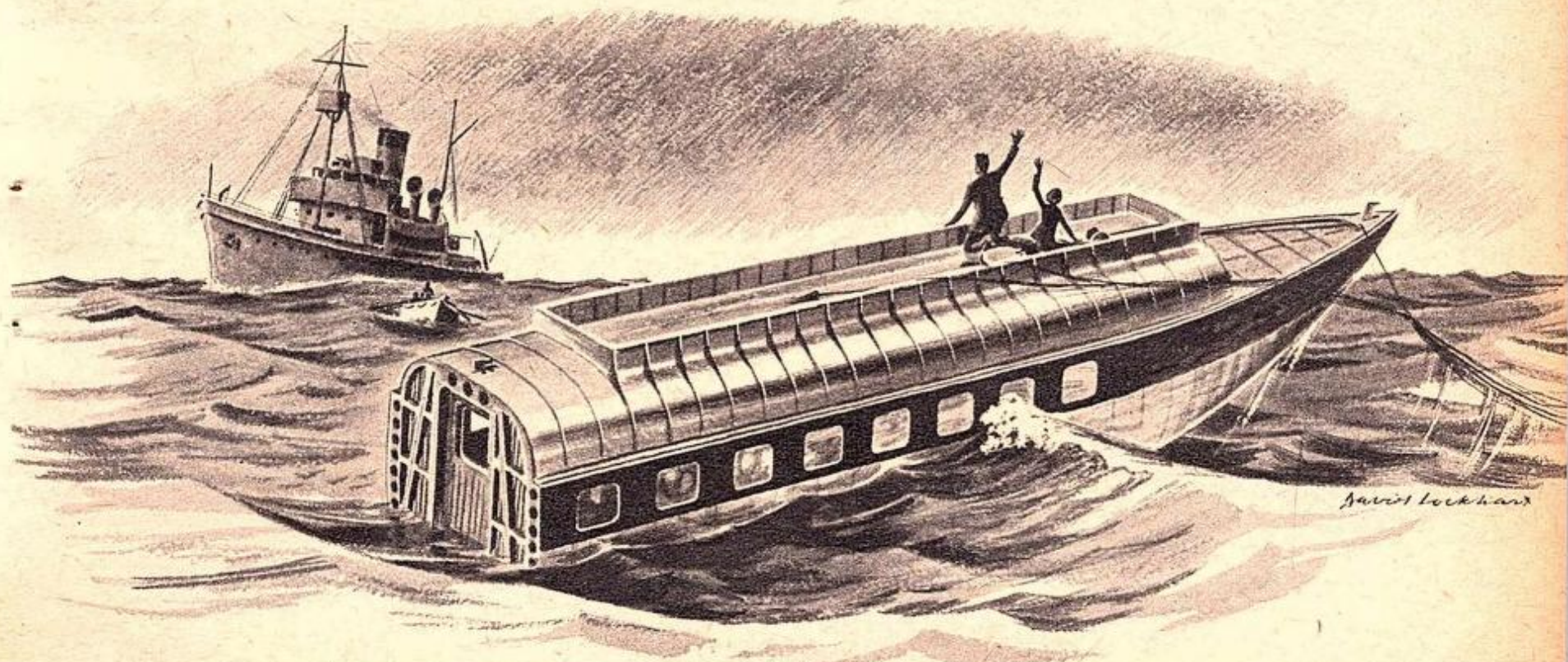


RESCUERS will be aided in their search for survivors by parachutes' vivid color.

Mid-air accidents are one of the few types which should offer some chance of escape. But the odds after a collision favor the military flier. He has a parachute. Airline passengers and crewmen do not.

Why can't airline passengers have a second chance, too?

Aboard ocean liners we find lifeboats. On military planes the use of parachutes is nearly universal. Yet aboard commercial [Continued on page 166]



AT SEA the pod makes an enclosed lifeboat. One of the chutes will serve as a sea anchor.

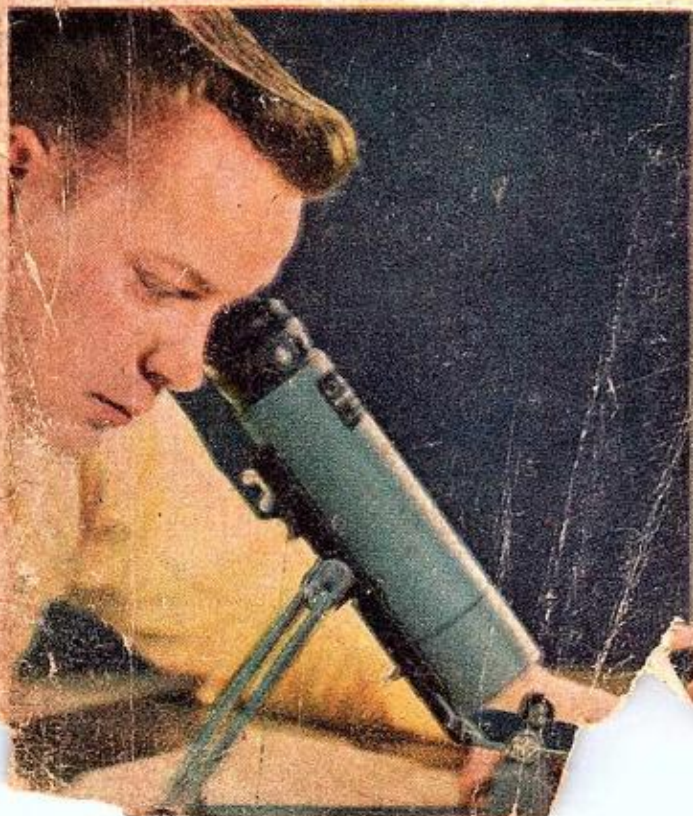
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THE HOW-TO-DO MAGAZINE

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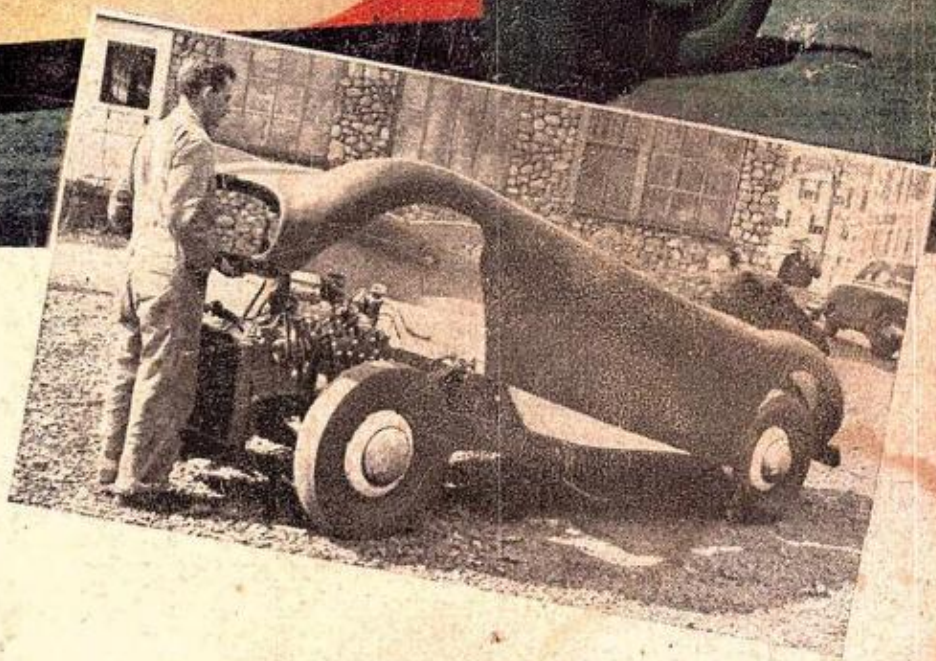
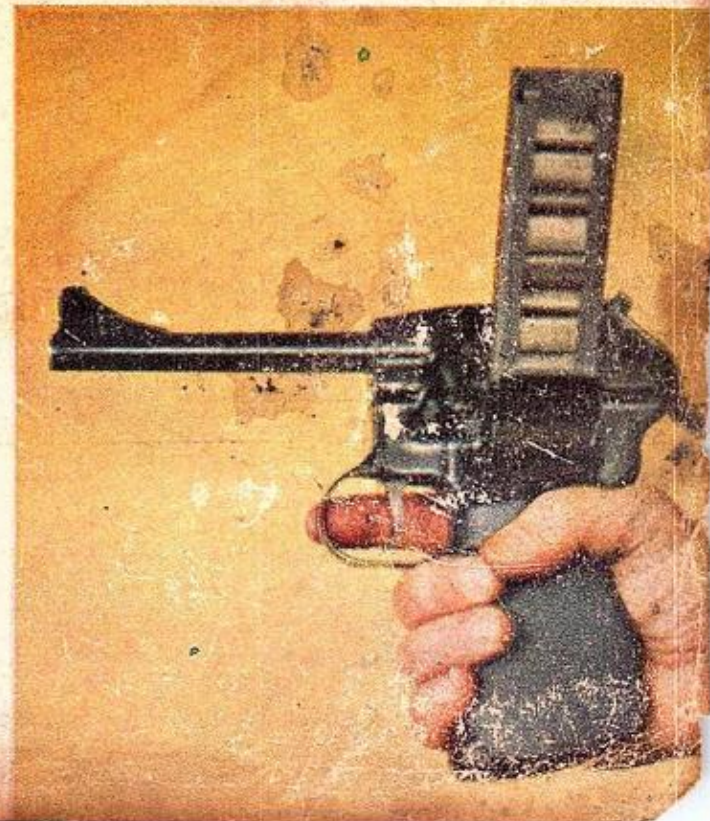
Exclusive!
SNEAK PREVIEW
OF THE
1958 CARS

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00!



→
**SENSATIONAL NEW
20-SHOT REVOLVER
FIRES TRIANGULAR
CARTRIDGES • Page 80**

←
**UNIQUE, LOW-COST
TELESCOPE LETS YOU
SEE STARS, COMETS,
SATELLITE • Page 152**



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AUGUST 1957

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VOLUME 53, NUMBER 8

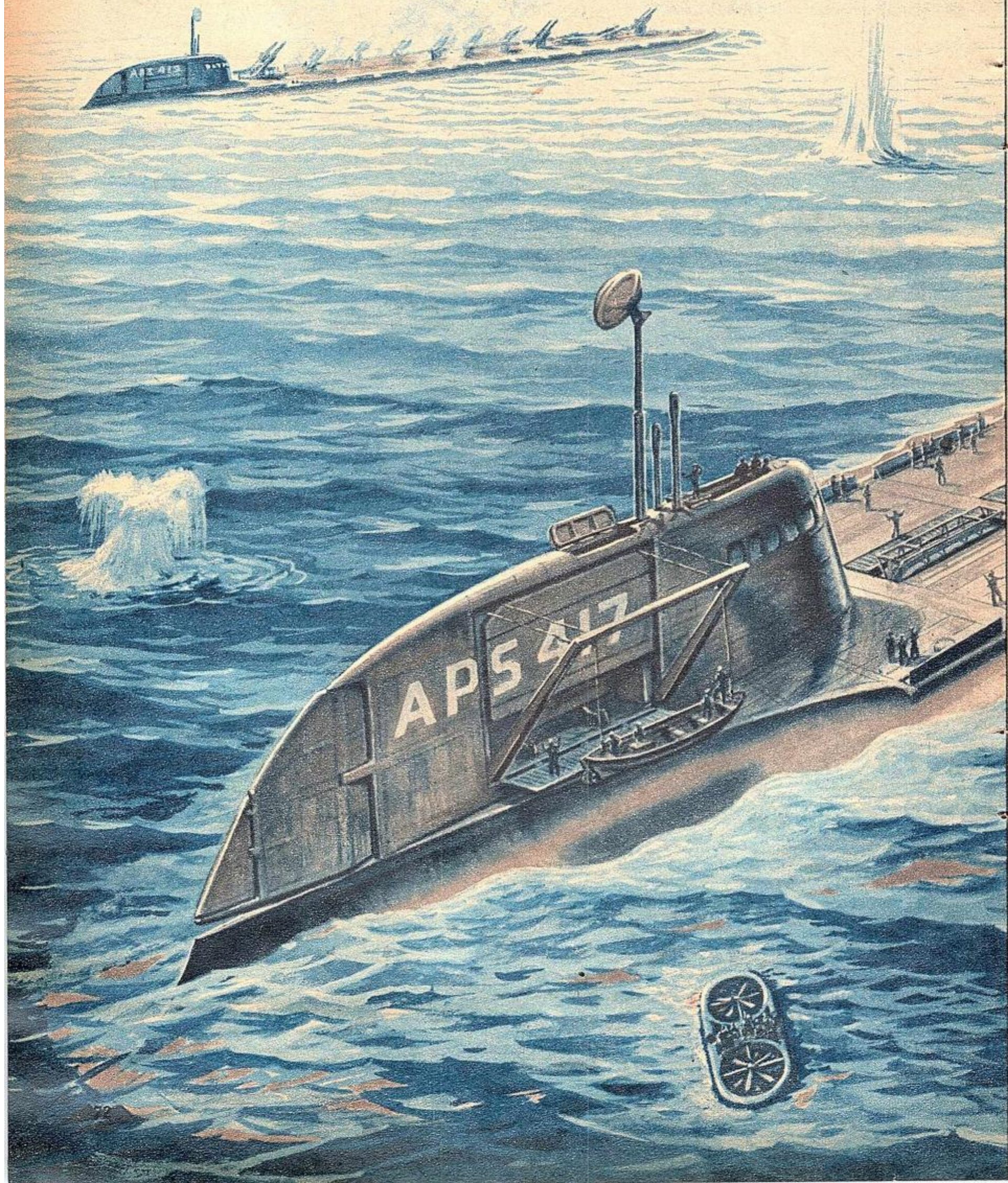
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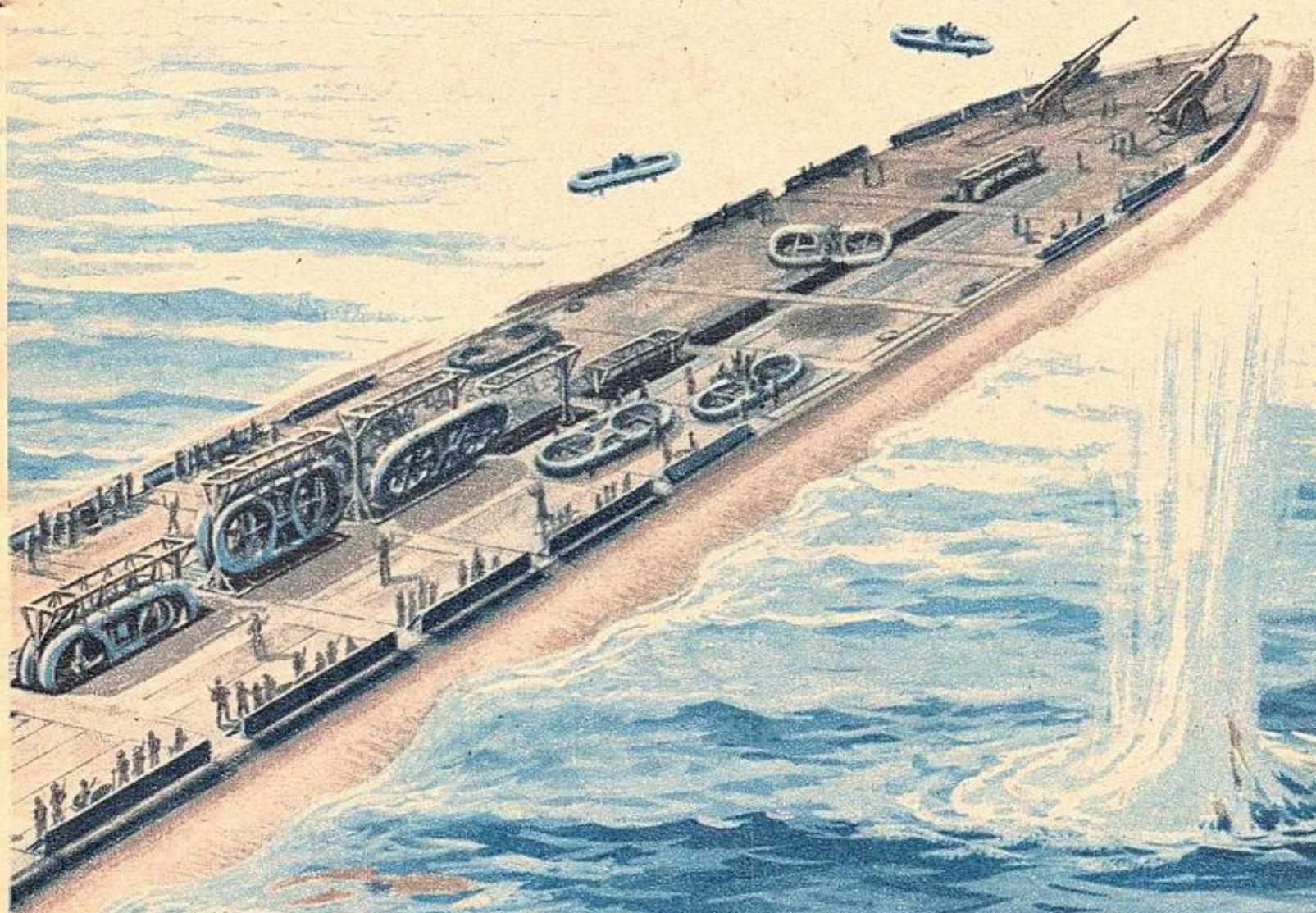
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Cover photos: Sports car by Rudy Arnold
 Telescope by Grayson Tewksbury
 Revolver by Mike Bonvino

Why Don't We Build **Giant Submarine**



Carriers



ASSAULT SUBS launch airborne Marines swiftly against a hostile beach.

*Massive assault subs
would make all enemy
coast defense futile.*

By Frank Tinsley

ADVOCATES of the submarine are not at all surprised at the news that the Japanese are building a 30,000-ton submarine tanker. As MI has been pointing out over the years, subs are the coming thing—the key to low-cost, fast, weather-free ocean transportation of all kinds. And even as a war weapon the sub is only beginning to come into its own. The sub you see above, MI's latest contribution to speculation on war technology of the near future, illustrates

one of the inevitable uses of the underwater ship.

Our giant assault sub, as you can readily see, is not of the traditional cigar-shaped type. It's made up of five cigar-shaped hulls—a sort of underwater catamaran. The reason for this design is that a cigar-shaped sub of this size, with 10,000 tons displacement and a keel-to-conning tower height of 100 feet, would not be useful in water less than 200 feet deep. Hence the flatfish profile.

Why retain the tubular hull at all? Because of its tried and proven strength to resist the terrible pressure of the ocean depths.

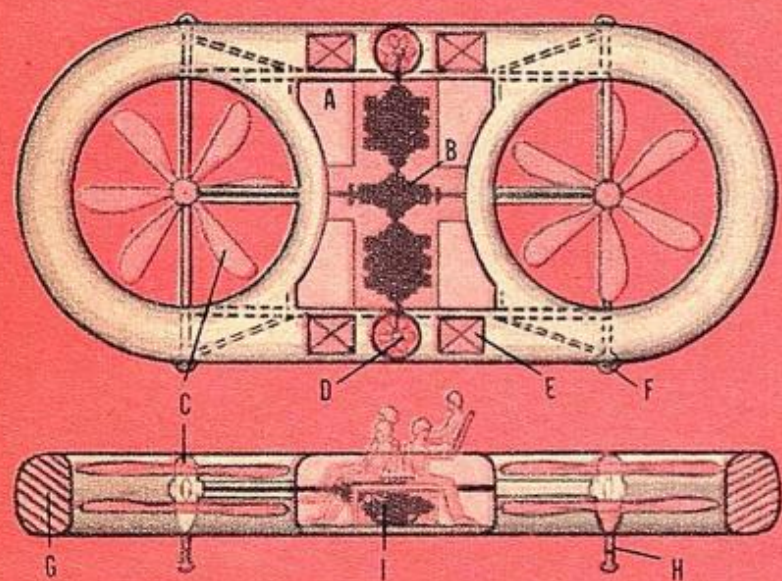
The bow component of our sub contains ground tackle, diving rudders and a battery of surface to air missile launchers. It may also be equipped

with a horizontal TV periscope to add a degree of underwater visual observation to the blind sonar gear.

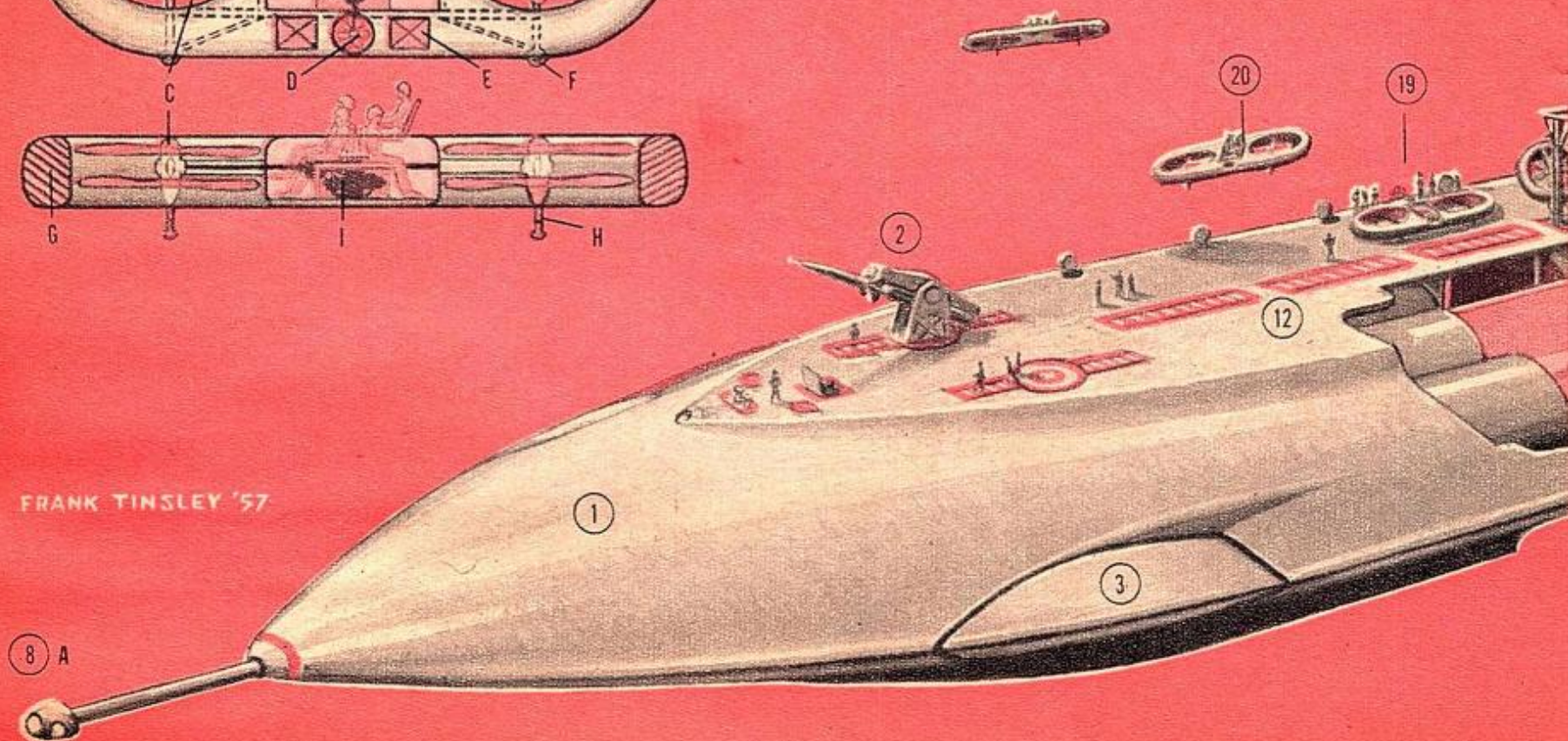
The body of the sub contains troop or cargo facilities, hangar space or missile storage depending on the use to which the hull is put. Above is a 48x300-foot flight deck, from which 20 squad-size "air rafts" can be launched at one time.

In the stern component are the operating controls, crew quarters and power plant. The conning-tower-directional fin houses periscopes, retractable radar mast, small boat stowage. The structure gives great stability to the vessel and the outsize rudder gives sharp control of direction. Under the stern component the two skid heels terminate in skegs housing the propeller shafts and smaller vertical rudders. Twin horizontal rudders are built into the flat fish-tail stern,

1. Bow compartment for mooring gear; 2. Retractable missile batteries; 3. Diving vanes;
4. Central cargo hold; 5. Stern compartment: controls, crew quarters, powerplant; 6. Conning tower with vertical rudder; 7. Control bridge levels; 8. Radar mast and periscopes;
- 8-A. Underwater TV scope; 9. Small boat stowage; 10. Atomic-steam propulsion plant; 11. Horizontal rudders; 12. Flight deck; 13. Hangar deck holds 40 air rafts; 14. Bilge sump with pump;
15. Air rafts stowed on elevator; 16. Loaded elevator rising to flight deck; 17.



FRANK TINSLEY '57



on either side of the keelson which contains the after hawsepipe and anchor.

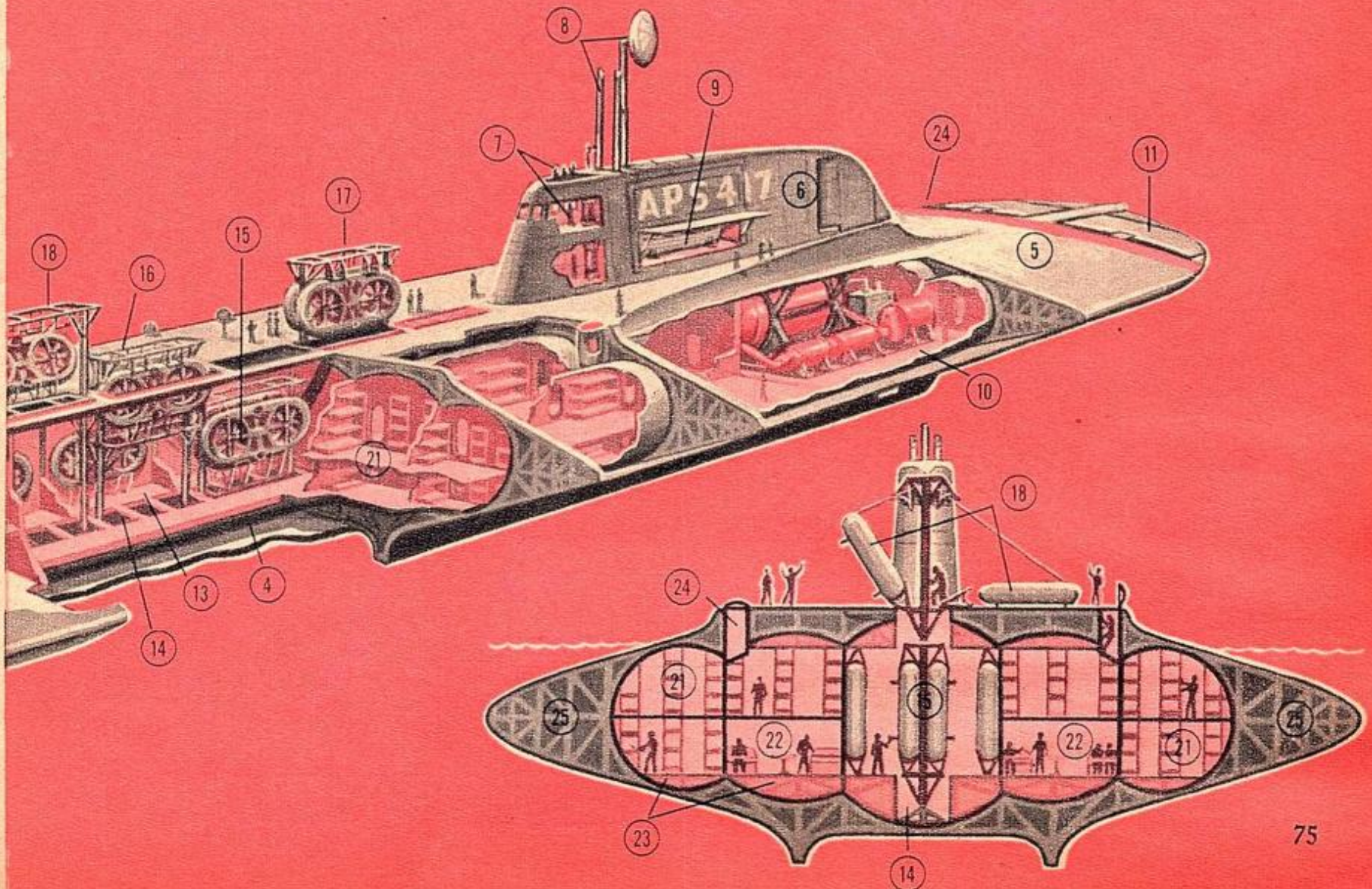
MI's submarine is 720 feet long with a beam of 124 feet. It can carry 2240 Marines in addition to crew, as well as 40 air rafts. The air rafts are twin-engined, amphibious flying platforms. Each is manned by a crew of two, carries eight fully armed Marines. Stowed in vertical racks, the rafts occupy minimal space below and present little target area in flight. With a speed of 100 mph, they can be launched from carriers lying well below the horizon and can reach objectives in a relatively short time.

Below decks the interior of the giant sub is a maze of watertight compartments. At the foot of the ladder leading down from the flight deck, one finds oneself in a vast dormitory—triple-

decker steel bunks line both walls with another tier down the center. In the mess hall where troops spend their waking hours, there are pleasant colors, restaurant-style booths, shelves of books, magazines and games.

During an assault the air rafts rise to the flight deck on their elevators, are set down horizontally and readied for flight. Assault teams come up through personnel hatches and scramble aboard. As the first rafts take off, others are brought up, having been transferred from wall racks to elevators on overhead tracks. The "ready" rafts are stowed on the elevators at all times. The rafts rise from the deck in regular order and head for their objectives. Shuttling back and forth at high speed they can land 2240 Marines in seven trips. •

Elevator at flight deck level; 18. Air rafts lowered to deck; 19. Troops boarding air rafts; 20. Air rafts taking off; 21. Troop quarters; 22. Troop lounge/mess hall; 23. Lobed pressure hull; 24. Escape hatch; 25. Buoyancy tanks. Above right: Air Raft Detail Key: A. Twin engines; B. Electromagnetic oil transmission; C. Contra-rotating ducted fans; D. Small side fans for lateral control; E. Fuel tanks; F. Eye rings for hoisting; G. Life ring for flotation; H. Legs for ground and deck landings; I. Eight-man assault squad.



WIN A SPORTS CAR IN BIG \$20,000 CONTEST!

MECHANIX ILLUSTRATED

THE HOW-TO-DO MAGAZINE

25^c
JUNE



TEST PILOT DESIGNS AMAZING
AUTOMOBILE FLYING BOAT—Page 84

Special Section: HOW TO FOR
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Volume 52, Number 6

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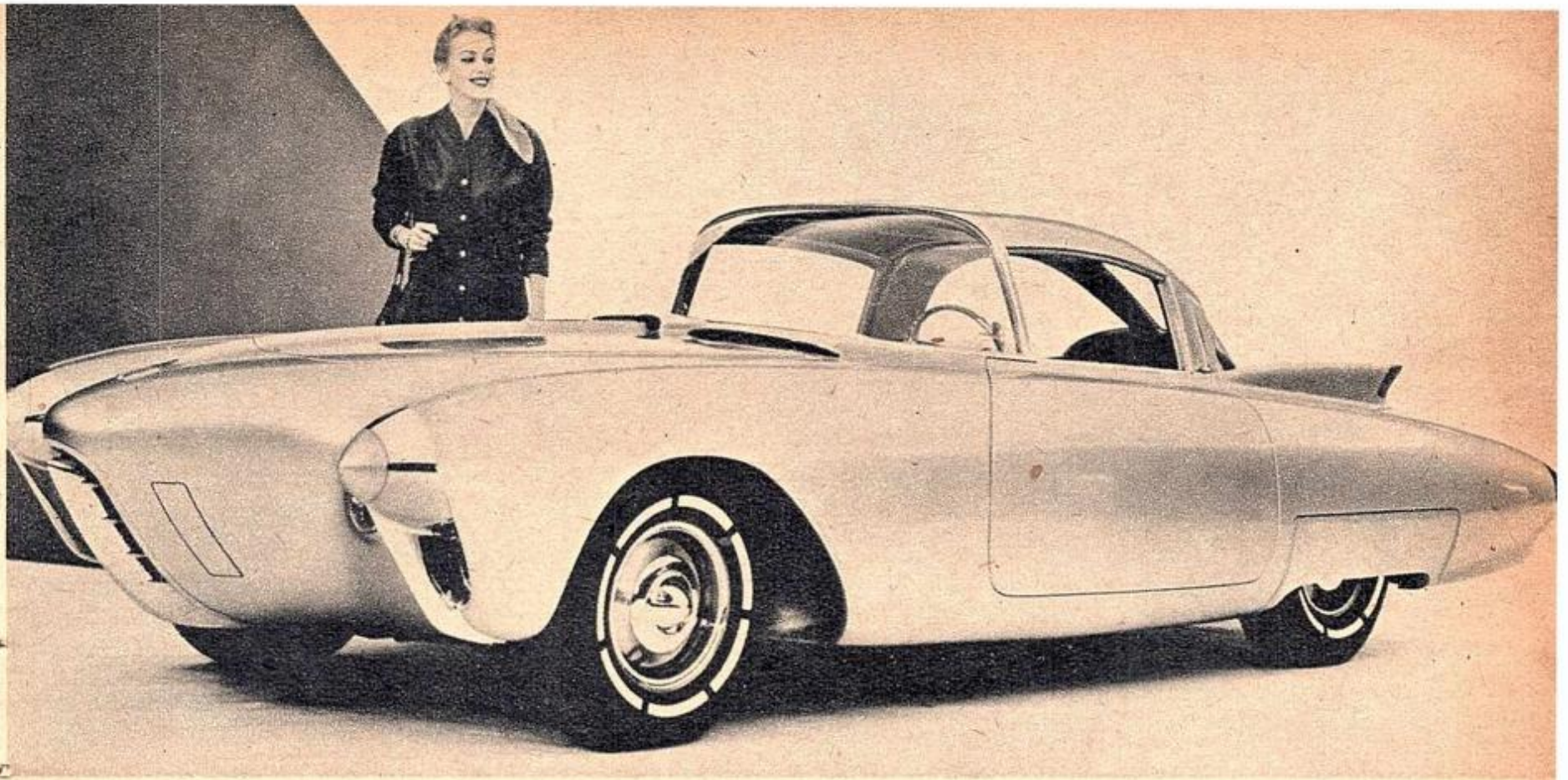
CAR OUTLOOK FOR 1957

Radar brakes, fuel injection, steel convertible tops, smaller wheels and lower silhouettes may make '57 one of the most exciting years in automotive history.

By Stanley H. Brams



Mercury's XM-Turnpike Cruiser has butterfly wing doors for easier entrance, exit. One maker may introduce them next year.



Oldsmobile Golden Rocket's 13-inch wheel diameter exemplifies trend to smaller wheels.

WHEN you slide behind the wheel of your 1957 car, the look from the driver's seat to the road (or from the road, looking at the car) will be quite different. And the way this model threads through traffic or responds on the highway will be pleasantly improved—as will the way it stops.

In short, 1957 cars promise advances and styling changes that haven't been possible up to now. Some of the improvements planned may not be ready but enough will come to make next year highly stimulating.

One of the most remarkable improvements in the works is the radar brake which might well be the first step toward

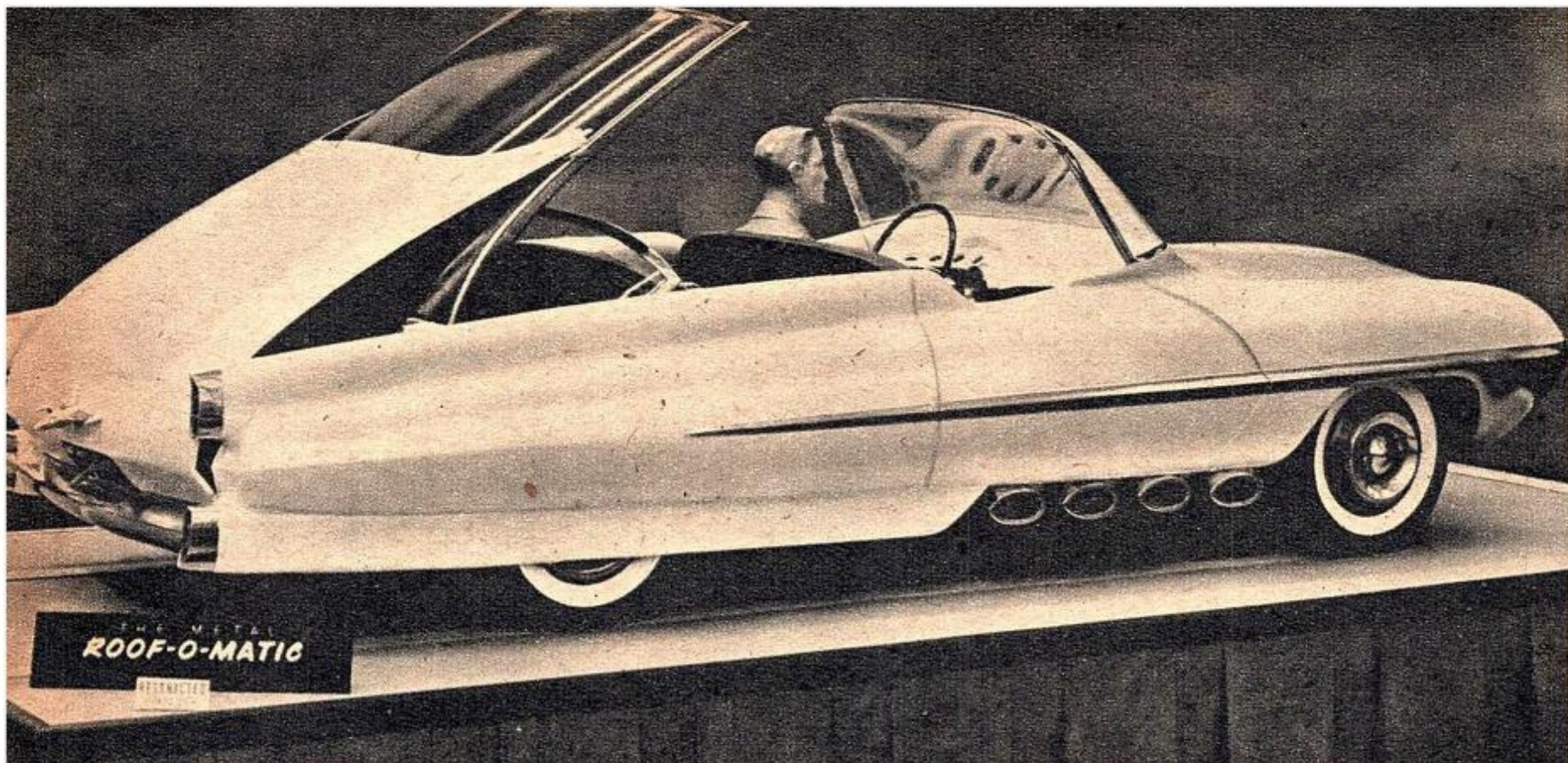
completely automatic car operation.

The radar brake will be directed by a screen mounted in front of your grille, small enough so that it will hardly be noticeable. From the screen will be transmitted bounce-back detection beams, just like wartime radar. Whenever the beams hit an obstacle ahead they'll message back to the brake system. The brakes will automatically take hold through a system of solenoids, reducing car speed even if the driver is unaware of what's ahead.

An adjustable "bounce" is hooked up with car speed so the safety factor will be as worthwhile at top highway speed, with greater distances between cars, as

Several '57 models, including Cadillac Brougham Town car, may feature four headlamps.





Ford Syrtis model's steel convertible top that slides into rear deck is on tap for '57.

it is at relatively modest speeds where you are apt to crowd closer to the car in front. Of course the beam can be cut off entirely for city driving so you won't be stopping and starting in continuous jerks.

Next year you will see a significant step in casing evolution. Wheels and tires will be smaller on many cars. Fourteen-inch casings will make a bow, not only a full inch narrower in diameter but tires that will need inflating only to

Detroit expects at least one maker to use fuel injection like this Mercury prototype.

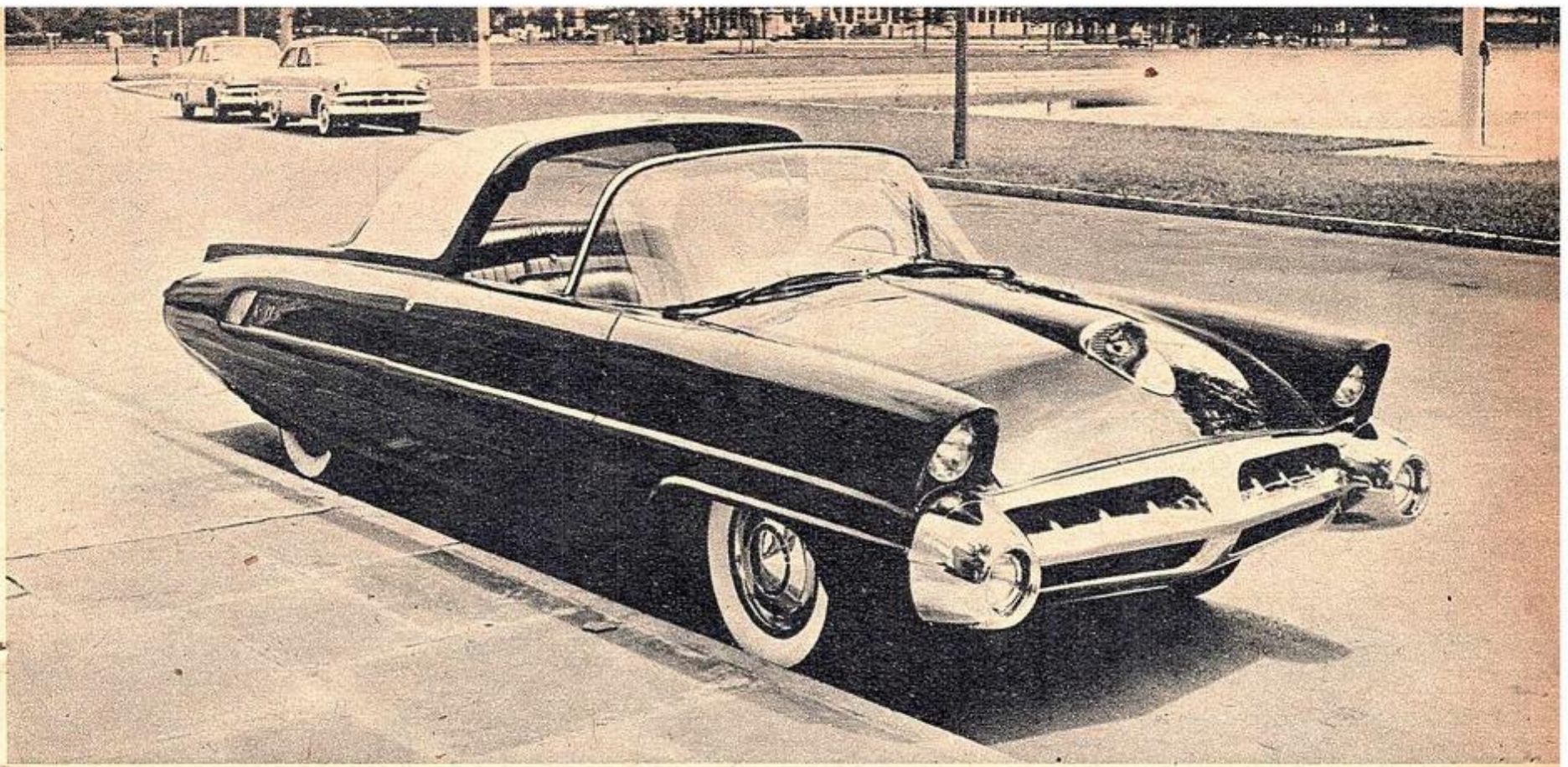


about 20 lbs. or so. The result will be an easier, softer ride, lowered silhouette, modestly faster acceleration and slightly less top speed.

In addition to radar brakes, there promises to be some other notable change in braking systems—a subject of concentrated study in the past decade when speeds and power have been increasing and brake development has lagged behind.

Reports are that 1957 will see disc brakes on more production cars. The virtue of these brakes is that more surface is provided than is possible with today's conventional cylindrical shoes. A circle of metal revolves with the wheel and pressure is applied against it by movable pads. Friction is spread over a larger area and cooling is somewhat improved.

Above the wheels will be new body shells that will be lower and, hence, look longer than ever before. Part of the new lowness will derive from the smaller tires and wheels; although a widened cross-section on the tires will eat up part of the one-inch savings in height that would otherwise be realized. Some more of it will come about in a natural, evolutionary sort of way with both floors and rooflines lowered so that passengers can sit closer to the ground without any sacrifice in headroom.



You'll be seeing more of the scenic slide-away plastic top, shown on this Ford X-100.

In order to maintain an unchanged amount of entrance room, and possibly to increase it, doors may reach farther upward. Some are likely to intrude a bit into the roof. One producer, at least, is thinking intently about introducing a so-called "butterfly wing" top to make entrance easier. This would follow the designing of some dream cars shown earlier this year. As the door opened a segment of the roof immediately above it would raise gently, like a wing, making it possible to move into the seat almost as you enter a convertible with the top down. Plans also call for a hardtop model whose entire roof (or most of it) will slide back into the rear deck, like an orthodox convertible.

In a more general sense, next year will likely see continuation of two approaches toward design, both of them considerably refined. One might be called the General Motors school of styling, with squarish hoods and rear decks. The other has been followed by Ford and Chrysler stylists and is characterized by a line rounding downward, particularly along the hood.

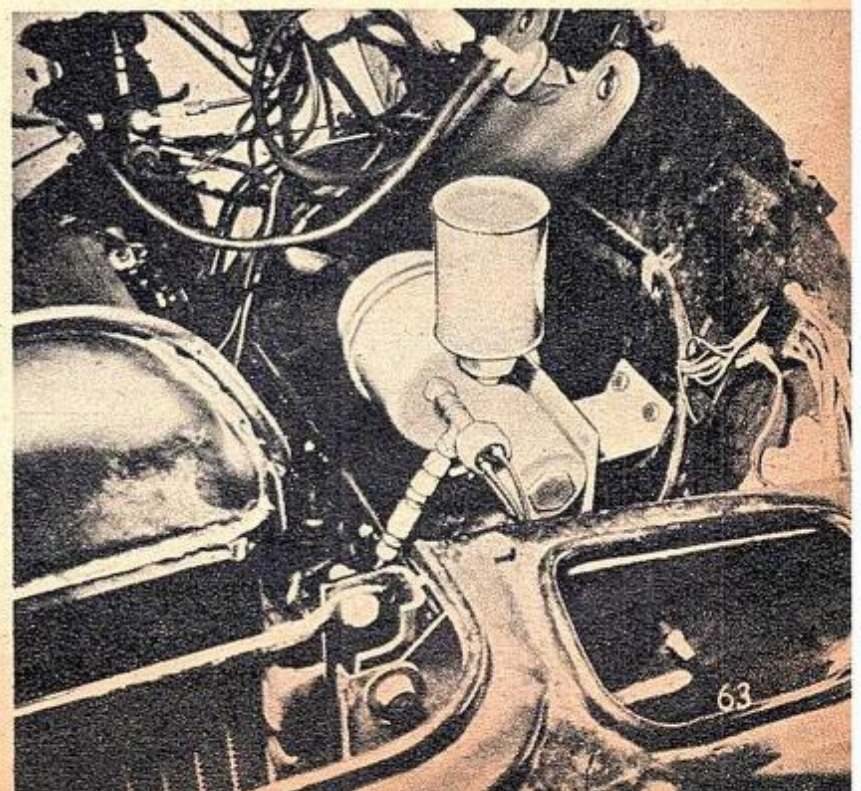
Both schools of design, however, seem bidding to go curvy on the sides. There is expected to be seen a gentle arc, wheel line to roof line, resulting in more ample hip room on the seats and in the better handling that derives from

a widened structure. That arc, too, will mean the introduction of subtly curved side glass.

More glass everywhere. That will be a hallmark of the 1957 models as it has been for a steady number of years. The glassmakers are hard at work providing not only larger and more intricately rounded panes but also stronger ones. Sun-filtering tinted glass will be standard on a number of makes.

The bright metal trim on your 1957 will stand up better than in past years. The reason is in the metallurgy of the material. More [Continued on page 171]

Centralized lubrication system developed by Stewart-Warner is slated for wider use.



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THE HOW-TO MAGAZINE

FEBRUARY 1980

**Pseudo-Oils That
Save You Gas**

**Solar Power
From Beneath
The Ocean?**

**Quick & Easy
Siding Repairs**

**Build MI's
UrbaSport**

It's a Striking Three-Wheeler That Runs on
Gas Power or Electric Power

**1980
HONDA CIVIC:
Tons of Fun
With a Social
Conscience**

ANNUAL BOATING SECTION

■ **SPORTY DIESELS:**
Boating's New Wave

■ **THE JOHNBOAT:**
What It Was, What It Is...

**And What Yours
Will Be**

Complete Plans in This Issue



**3 Classy
Cabinets
You Can
Build Fast!**



02

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Build UrbaSport— A Car for All Reasons

By Robert Q. Riley & David L. Carey



GETTING into the Trimuter is facilitated by gas cylinders that help raise canopy. Inside it's snug, like fighter plane's cockpit.



DUAL-RECTANGULAR headlights make UrbaSport street legal. When off, lights hide.



NOT common sight on our roads (yet), UrbaSport Trimuter moves easily with traffic. Electric, gas versions both top 50 mph.

BACK in 1975 we started the Urba series of build-it-yourself cars with UrbaCar. We followed that up in '77 with Urba Electric. There were good reasons for building those cars at the times we brought them out. There still are plenty of good reasons for building them. You only have to check the price of gas and the crowds at the pumps and on the highways.

Now we have the latest in the Urba family line—UrbaSport. And it's a personal transportation

machine for now, for all the same good reasons, plus some. And, like its predecessors, you can build it yourself.

UrbaSport differs from its fore-runners by having three wheels instead of four—one front, two rear. That striking design leads to the car's distinctive and efficient wedge shape. It also means that UrbaSport is a motorcycle and not a car in the eyes of the federal government. For that reason, it doesn't have to meet the extremely

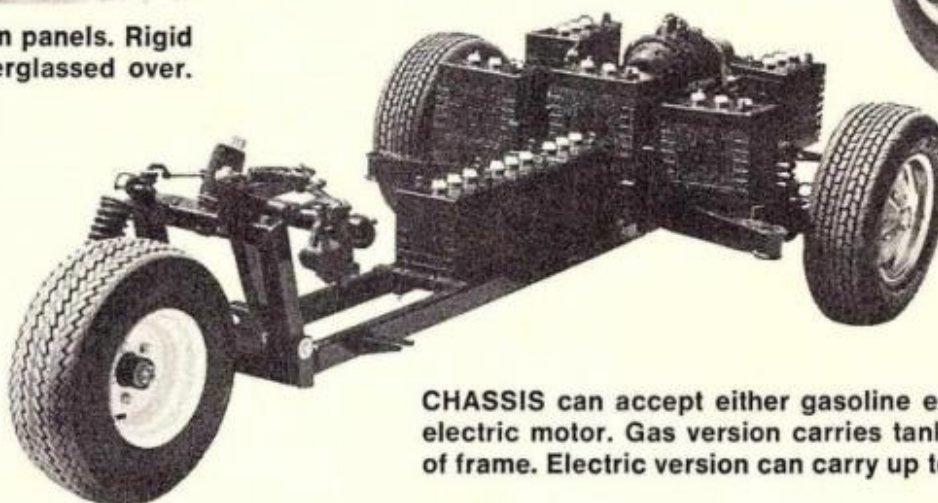
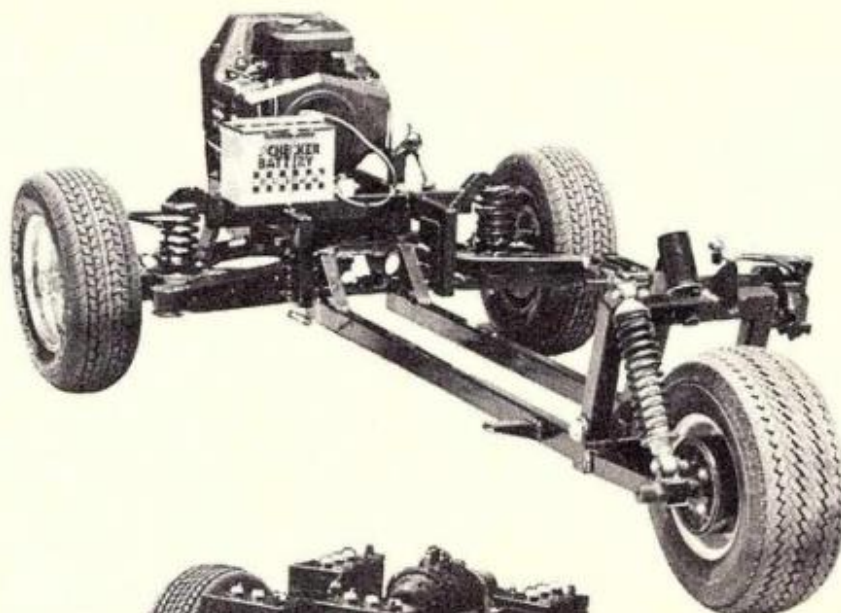
tough standards that new cars do.

There are some added benefits, too. It costs less to license than a car. The three-wheel chassis is lighter and has less rolling resistance than a four-wheel. It also has an easier-to-build front suspension and steering assembly.

In addition, UrbaSport can be built with either a gas engine or electric motor for power. Both chassis and body are designed to accept either. That makes the two-seat UrbaSport an ideal commuter



BODY of rig is made of 1-in.-thick urethane-foam panels. Rigid material is cut to size and shape and then fiberglassed over.



CHASSIS can accept either gasoline engine (top) or electric motor. Gas version carries tank down center of frame. Electric version can carry up to 10 batteries.

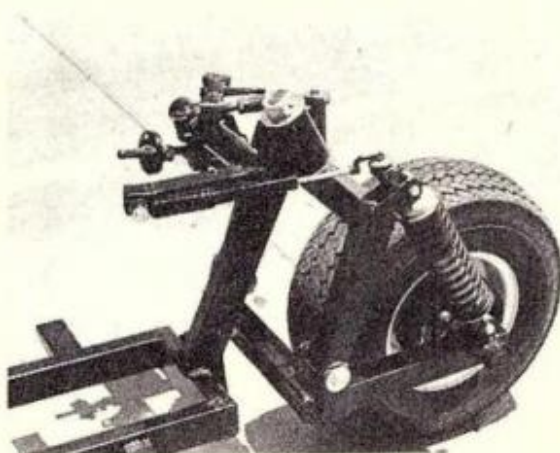
vehicle—sort of a commuting three-wheeler. Matter of fact, that's how we look at it. So we gave it an appropriate name. We call it Urbasport Trimuter.

The gasoline version gets 50 miles to a gallon of regular gas, about the same as a large motorcycle. The electric version runs 50 to 60 miles on a single charge. Either version can reach a top speed of 60 mph, enough to get you a ticket anywhere in the U.S. Cost is about \$1,900 for the gas version and about \$2,700 for the electric version. Plans cost \$15 and cover both models.

Styling is clean and functional. The sleek, aerodynamic shape lets Urbasport slip through the air with minimum drag. The clamshell canopy makes for easy, unobstructed entry into the low-profile body. Two nitrogen cylinders, one mounted on each side of the canopy, provide an assist against the weight of the canopy so it can be opened or closed with just a nudge.

To enter, you step over the side and slither down into the contoured bucket seat formed into the fiberglass body. You see, you don't ride Urbasport, you wear it like a close-fitting overcoat. It fits like it was molded to your body. It's a comfortable, snug feeling, something like you might expect to feel inside the cockpit of a fighter plane.

The few controls inside are within easy reach on the stainless-steel-covered center console. A rectangular-shape rocker switch on the left of the console operates the hidden headlights. A toggle switch to the right of the headlight switch operates the turn signals (they beep). A rocker switch on the right turns on the accessories. A



SINGLE-WHEEL front suspension sports wheel and brake assembly from a trailer. Steering box and dampener are from VW.

PLANS AVAILABLE

A complete Urbasport Trimuter Plans Package is available from Mechanix Illustrated.

The package includes a 28-page booklet with step-by-step photos. There also are 12 sheets of plans, each a large 17x22 inches. The plans are for both the gas and electric versions. Also included are tips on how to find many of the parts, as well as other useful information.

For a complete set, send \$15 (check or money order) to Mechanix Illustrated, P.O. Box MG, 32275 Mally Rd., Madison Heights, Mich. 48071. Specify Plans Package C-2-80.

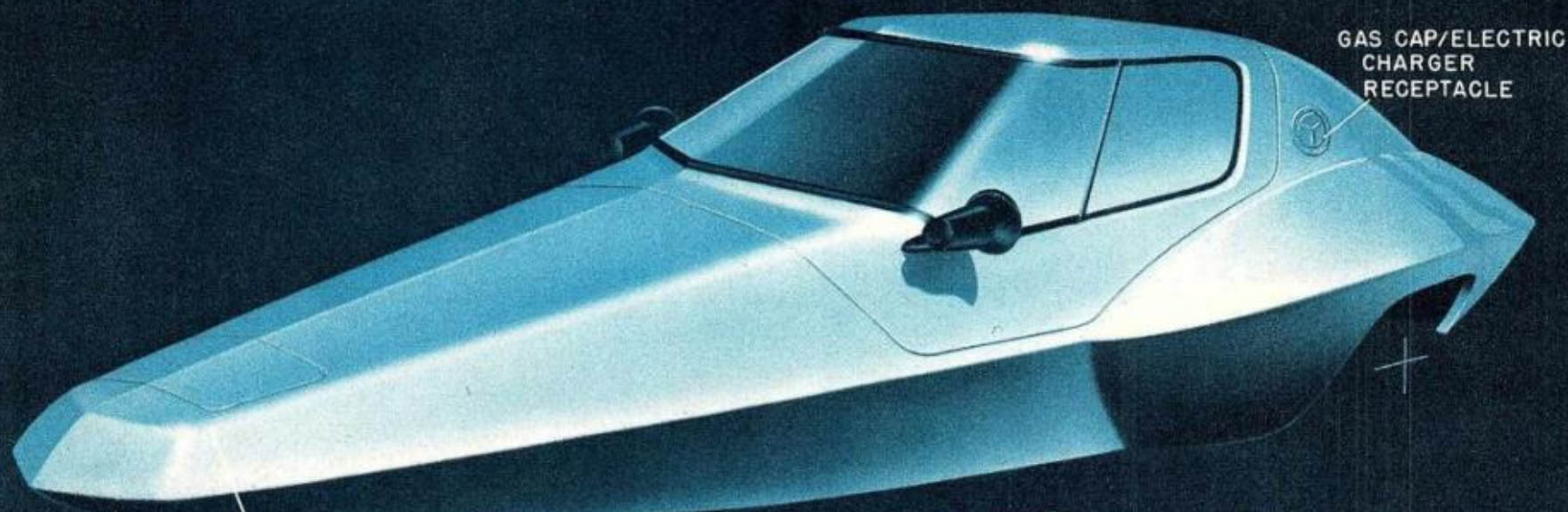
large black button just behind the other switches is the horn and it falls right under your hand if you're using the console as an armrest.

Flipping the accessories switch lights up a dash-mounted LED digital display instrument package and an on-board computer. Urbasport has no dial gauges. All such information, including speed, is given as digital readouts. The computer, located between the two instrument pods, gives readouts for fuel consumed, distance traveled, instant miles per gallon, average miles per gallon, time of day and time elapsed since the trip began.

These LED instruments are about \$500 worth of extra goodies and are not included in our estimated cost to build. Our original idea was to install the computer so we could have instant mpg figures for the gas-power prototype. Once we got hooked on the LEDs, though, things simply got out of hand. They are a fun, but expensive, luxury.

The 16-hp Briggs & Stratton 2-cyl. engine is mounted in the rear over a Datsun differential and comes to life with a flick of the key switch. Since the transmission in the gas-power rig is an automatic centrifugal unit, similar to those in snowmobiles, there is no gearshift. The transmission is in Neutral

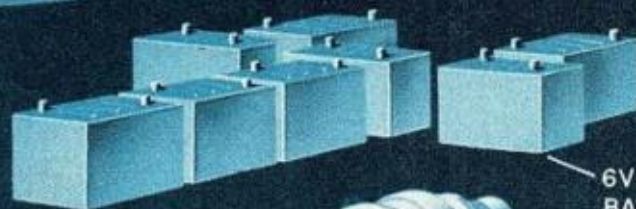
(Continued on page 136)



GAS CAP/ELECTRIC
CHARGER
RECEPTACLE

FOAM/FIBERGLASS BODY

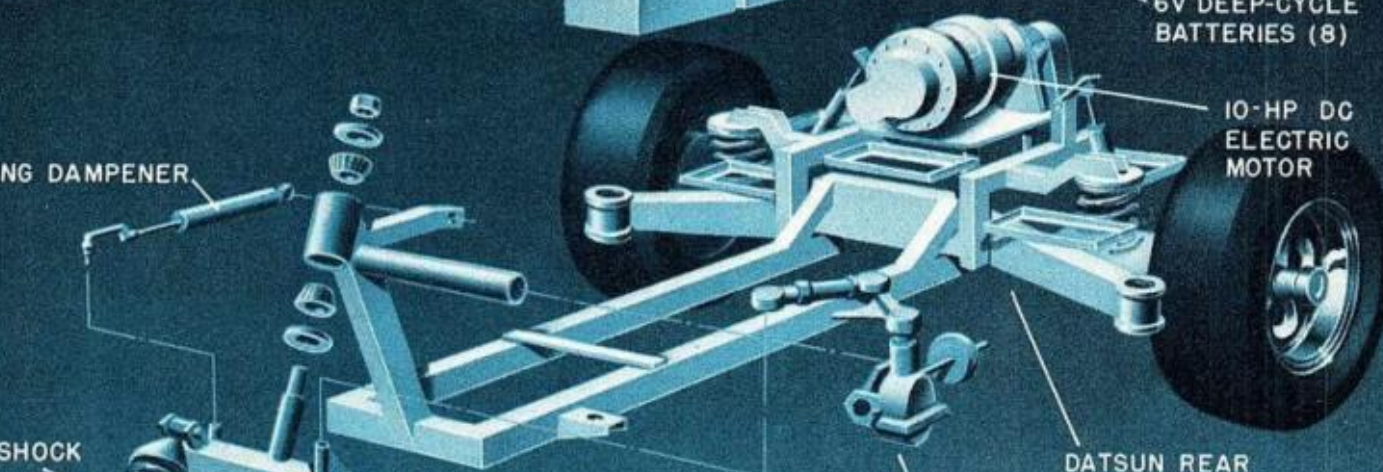
RETRACTABLE HEADLIGHT



6V DEEP-CYCLE
BATTERIES (8)

STEERING DAMPENER

FRONT SPRING/SOCK
ASSEMBLY



10-HP DC
ELECTRIC
MOTOR

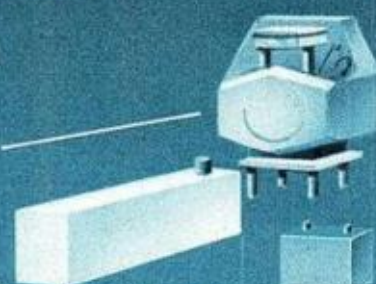
DATSUN REAR
SUSPENSION ASSEMBLY

VW STEERING BOX

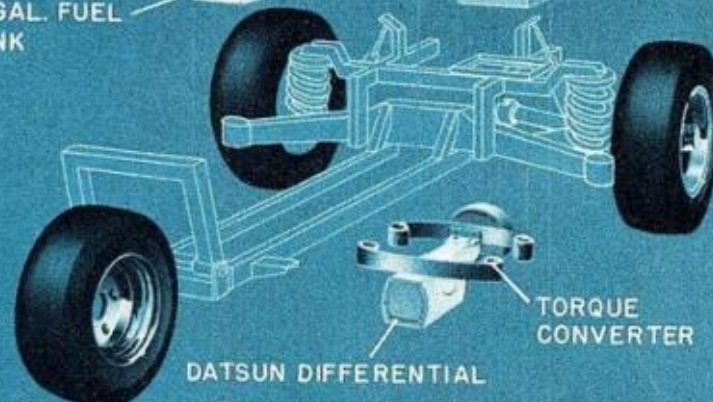
FRONT SUSPENSION/STEERING
ASSEMBLY

16-HP 2-CYLINDER
AIR COOLED GAS
ENGINE

17-GAL. FUEL
TANK



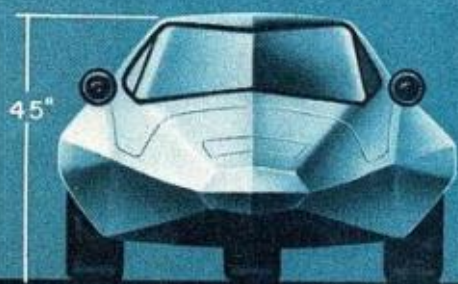
LIFT-UP CANOPY FOR ACCESS



TORQUE
CONVERTER

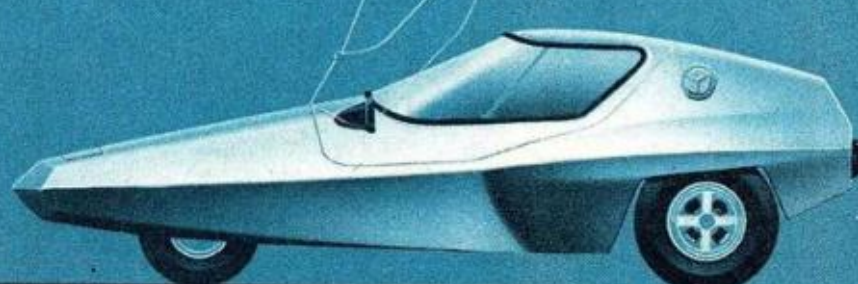
DATSUN DIFFERENTIAL

GAS VERSION



45"

67"



146"



54-1/2"



Ocean Power Hits Hawaii

By Hank White

WHEN you're out to prove a point, many times you have to start out small.

That's exactly what the State of Hawaii, Lockheed Missiles & Space Co. and Dillingham Corp. have done to show the faith they have in the concept of using temperature differences of ocean waters to provide a substantial amount of energy in the form of electricity.

For Mini-OTEC (Ocean Thermal Energy Conversion), a 50-kilowatt electrical generating system now operating in Hawaii, has proved that the concept works and that electricity from the sea could be a very real power for the future.

Conceived back in 1881 by Jacques d'Arsonval, a French physicist and physician and inventor of the galvanometer, OTEC is nothing more than a simple heat engine using the difference in temperature between warm surface waters and deeper, colder ocean

waters to vaporize and condense a working fluid (ammonia in the case of the Mini-OTEC experiment). This energy change, in a closed cycle, is used to turn a turbine which operates a generator.

Actually, the concept is very much like the common window air conditioner, except its cycle operates in reverse. Instead of using electricity to produce heat on one side and cold on the other, OTEC uses heat and cold to produce electricity.

Built on a U.S. Navy dump scow, Mini-OTEC is only one-thousandth to one-ten-thousandth the size that commercial OTEC plants may attain someday. But, in miniature, she does everything that they would.

One important element of the Mini-OTEC system is her unique mooring system, which enables her to bring up deep cold water at minimum cost. Mini-OTEC is located in 3,080 feet of water about a

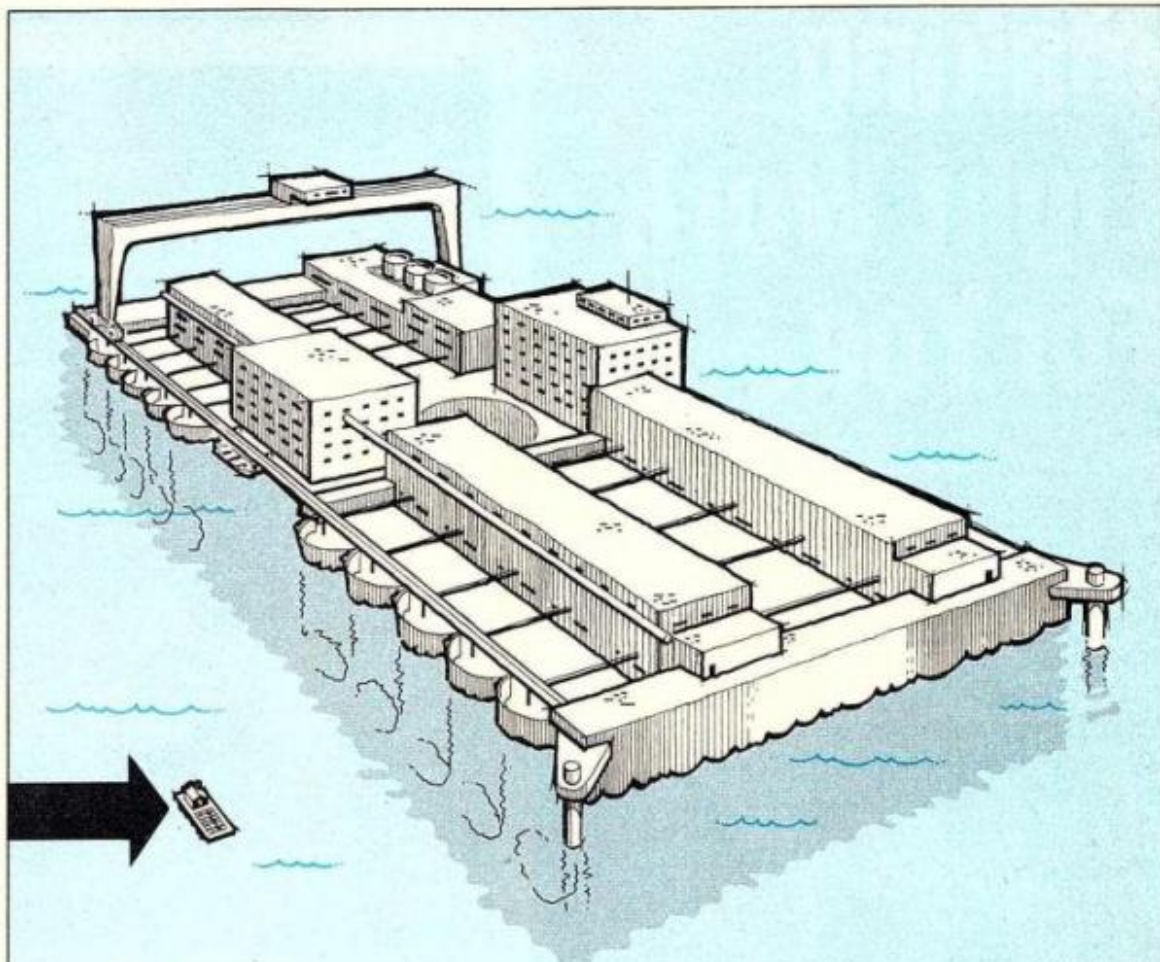
mile and a half from Keahole Point on the Big Island of Hawaii. A 15-ton concrete block was lowered to the bottom by Dillingham and, attached to it, was 1,500 feet of nylon hawser. This line was, in turn, attached to the bottom of a 2,170-foot-long piece of 24-inch-diameter polyethylene pipe.

All of this mooring equipment terminates at a buoy on the surface. Mini-OTEC is attached to the buoy by a flexible cold-water transfer hose. This type of mooring system allows the OTEC plant to withstand heavy seas and winds (which are extremely rare off Hawaii's Kona coast). The overall system uses the cold-water pipe as a tensile member of the mooring system. In the event that a rare offshore wind does threaten to drag Mini-OTEC away from land, the submerged concrete block is prevented from bouncing down the 30-degree slope by a 1½-inch steel cable moored to the inshore reef.

Currently, the cold water from the depths is sucked up through the pipe system to a free sump on the barge, where it is pumped at the rate of 2,700 gallons per minute through the condenser. The water is finally mixed with an identical amount of warm water coming from the evaporator and the two effluents are discharged through a common pipe 16 feet below the surface. During the summer months, the water temperature from the 2,100-foot level is approximately 43°F and the surface water is about 81°F. In wintertime the surface water may go down in temperature to 75°F, but that still gives enough temperature difference for Mini-OTEC to operate.

Due to her minuscule size, Mini-OTEC makes just a little more elec-

CONCRETE block that holds the Mini-OTEC in position is lowered to the sea bottom. Block weighs 15 tons, is itself moored.



MAXI OTEC

FUTURE OTEC system of giant proportions would moor in tropical waters and grind out 100 megawatts of electricity from the temperature differences of the sea. Compared to Mini-OTEC (left), it would be a mon-

ster, complete with multistory crew quarters, water ponds and gravity-feed heat exchangers covering a large portion of the topside area. Electricity would be fed ashore by way of undersea cable on ocean floor.

tricity than is required to run all her subsystems. Her generator puts out about 50 kilowatts. Of this amount, 40 kilowatts is used in running pumps, compressors and the like. The additional 10 kilowatts burns lights, TV and small appliances for the crew who have absolutely no guilt complexes about wasting fuel.

It's quite a sensation to be aboard the barge seeing all the pumps turning away, powered silently by turbine. The only sign that might give a clue to the source of the power is the continual drip of condensation from the cold side of the plant.

What of the future? Potentially, there are two main categories of OTEC plants: Some are sited near coastlines, moored to the bottom like Mini-OTEC, and send power ashore through cables (these, however, are limited in number due to the comparative rarity of appropriate sites) others are grazing



DIVERS inspect underwater workings of Mini-OTEC plant. Cool water is brought from below in a 2,170-ft. polyethylene tube.

OTEC plants—huge ships larger than present oil tankers. They would graze along the surface of the sea looking for warm pools of water spotted by satellites. These mobile plants would convert their electrical energy into hydrogen for shipment to continental ports, where the hydrogen could be burned as a fuel, leaving only a residue of fresh water. They

could also manufacture ammonia to be used as fertilizer for agricultural countries.

Mini-OTEC is a little like the Wright flyer—a lot of people have talked about the concept, but she is the first to actually generate net power from the ocean thermal resource.

Mini-OTEC was assembled mainly from off-the-shelf hardware by Lockheed using equipment from a number of sources. The plate-type titanium heat exchangers were designed, built and donated to the project by Alfa-Laval, a Swedish outfit. The turbine and generator subassembly was built for Mini-OTEC by the Rotoflow Corp. The plant's two seawater pumps each providing 2,700 to 3,300 gallons of water per minute, were custom-made by the Worthington Corp.

There is little point in running a wire ashore to sell Mini-OTEC's

(Continued on page 140)

A Breadbox-Size Navigating System

By R. F. Gallagher

WE'RE all navigators to some degree. Navigating is simply finding your way from one place to another and knowing where you are along the way. Usually, though, we think of navigating in terms of ships and planes.

Navigating systems have come a long way since Capt. Bligh's famous 3,600-mi. journey on the South Seas. All he needed was a sextant because all he really wanted to do was get within sight of land. He even might have considered sailing to within miles of a pile of rocks pinpoint navigation.

That kind of accuracy isn't good enough nowadays, of course. And hasn't been for a long time. These days navigating means landing a craft on the moon (some 238,000 mi. away) with an accuracy down to $\frac{1}{2}$ mi. Or orbiting a craft around the planet Jupiter (almost 400 million mi. distant) with accuracy down to 1 mi.

MASTER CONTROL STATION
(FORTUNA AF STATION, N.D.)

VANDENBERG AFB, CALIF.

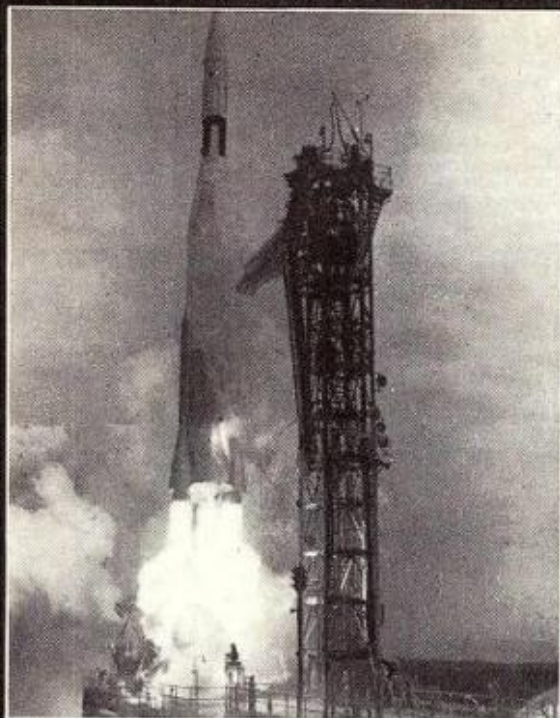
ALASKA

HAWAII

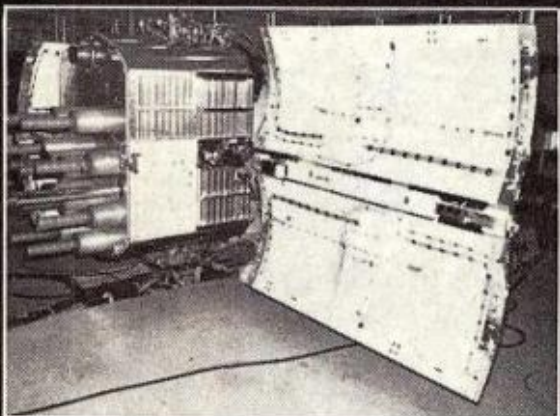
GUAM

MAJOR SEGMENTS of Navstar navigation system are shown in conceptual drawing. Space segment (satellites) broadcasts position and timing data. User segment (receivers) processes information from four favorably located orbiters to obtain accurate position and velocity components. Control segment (base stations on earth) tracks satellites and updates position coordinates. Our artist has taken some license in locating the Master Control Station and the four monitor stations, all of which are on U.S. territory.

Robert Winter Gato



FAMOUS Atlas family of rockets is Navstar's ticket into orbit. Here, rocket boosts Ranger soft moon-lander into space.



MOST of us never see a satellite at such close range. Navstar hardware undergoes test at Rockwell plant in Seal Beach, Calif.



BREADBOX-SIZE navigating system produced by Magnavox is now being tested at Army's Yuma Proving Ground, Yuma, Ariz.



MASTER Control Center at Fortuna AF Station as seen in artist's rendering. Construction is expected to begin in 1980.

You may think that that kind of navigating precision has not much to do with workaday types with both feet on the ground. You may be proved wrong some years down the pike. For the Air Force's Space and Missile Systems Organization (SAMSO) is now developing Navstar, a space-based radio navigation system—global in scope—that could provide precise navigation information by the late 1980s for users throughout the world. (A lightweight backpack model—which could be called *breadbox* size—has been built and is currently being tested for use by ground troops.)

The Global Positioning System (GPS) is a Dept. of Defense project, but the Air Force, Army, Navy and Marines, plus the Defense Mapping Agency, are involved. SAMSO is head honcho, or program manager.

Right now, there are four satellites orbiting the earth, the last of which was launched last December. All have been put up there by the famous Atlas family of rockets. When the project becomes fully operational, possibly in the late 1980s, the Navstar system will include 24 satellites, eight in each of three orbits. This truly artificial galaxy will circle the globe every 24 hrs., all the while beaming continuous navigation signals to earth.

SAMSO is currently working with the Federal Aviation Agency to determine the practicality and long-range use of the Navstar system in aircraft crash avoidance. Present aircraft applications are in strategic defense, with Navstar affording an all-weather, day or night global strike capability.

Another function of the system is to provide navigational fixes for missile and attack submarines which must broach the surface for as short a time as possible to avoid detection. The data received permits the craft to navigate through minefields and to pinpoint location relative to charted buoys, shoals and reefs.

The fully operational Navstar system works like this: All 24 satellites transmit individually coded, 30-sec. navigation messages simultaneously, beginning at the same time and in the same format.

The first 18 sec. contain celestial and clock data. The next segment of 6 sec. is reserved for additional messages. The final 6-sec. portion contains a course almanac for all satellites in the network.

Here on earth, the signals are received by user sets, which can be integrated with aircraft and ships or hand-held by land-based personnel.

The receiver locks onto signals from four favorably located satellites. It then processes the signals and, depending on the information sought, the user can determine his position to within tens of feet, velocity to within a fraction of a mile per hour and the time to within a millionth of a second. This information becomes available quickly with the push of a few buttons—no more difficult than punching numbers on a calculator.

The system consists of three major interlocking segments. The space segment (the orbiting satellites) broadcasts superaccurate position coordinates and timing information. The user segment (receivers) processes this information from the four best-located satellites to obtain accurate position and velocity components. The control segment (base stations on earth) tracks the satellites and continually updates their position coordinates.

The control segment consists of a Master Control Station located at Fortuna Air Force Station in North Dakota (construction is expected to begin in 1980), plus four monitor stations—in Alaska, Guam, Hawaii and at Vandenberg AFB, Calif. The monitor stations pick up signals from satellites and transmit them to the Master Control Station. These signals are used to determine and correct the errors of each satellite. The corrections are then relayed to the satellites by the Master Control Station.

The satellite itself weighs 1,673 lbs. and measures just 17½ ft. from tip to tip. And, of course, its more than 33,000 parts are a wonderment of sophisticated engineering. For example, the atomic clocks used are so accurate that they gain or lose only 1 sec. in 30,000 yrs.!

The Navstar Global Positioning System, as we hinted, is a little premature for civilian use. But near-future applications involving air, sea and land vehicles abound. They include aircraft runway approaches, photomapping, geodetic surveys, aerial rendezvous and refueling, air traffic control and search & rescue operations.

Further ahead, perhaps commercial fishermen, private-plane pilots, surveyors and offshore oil-drilling outfits might plug in. ●

'80s TECHNICAL REPORT

NEW ENGINEERING FOR THE J-CAR

Car is a four-passenger and has enough interior volume to be rated a compact by the EPA. Front seating room is quite ample; rear is no worse than most imports—and better than some.

Attention to the details of the car's finish shows in places like trim moldings, which have plastic end caps, and the paint job. The car is wet-sanded prior to painting.

Doors' outer shells are one-piece stampings and doors are mounted on welded hinges. This is to insure that they're hung evenly on assembly. There's only minor provision for adjustment of the striker plate.

Front suspension is the usual setup of MacPherson struts, borrowing from other small front drives:

All-new, 1.8-liter (112-cu.-in.) pushrod Four, designed and built by Chevrolet for the J-Car, is rated at 88 hp, making it GM's most power-efficient engine.

Transaxle is borrowed from the larger X-Cars. Both automatic and manual four-speed overdrive are available.

The body side panel, from leading edge of front door to the rear edge of rear fender, is one piece. This allows for closer tolerances and better fit of all related parts.

Chevrolet Cavalier



SOMETHING OLD, something new, something borrowed and something blue are themes that may be loosely applied to the new General Motors transverse-engine, front-drive J-Car.

The three areas where the saying is most applicable are the engine, the suspension and the body.

ENGINE

The mixed-bag look is particularly noticeable on the engine. In an era when aluminum-head overhead cams represent state-of-the-art, GM has designed a 1.8-liter (112-cubic-

inch) pushrod Four, that's all cast iron and which seems like its engineering is out of the 1950s.

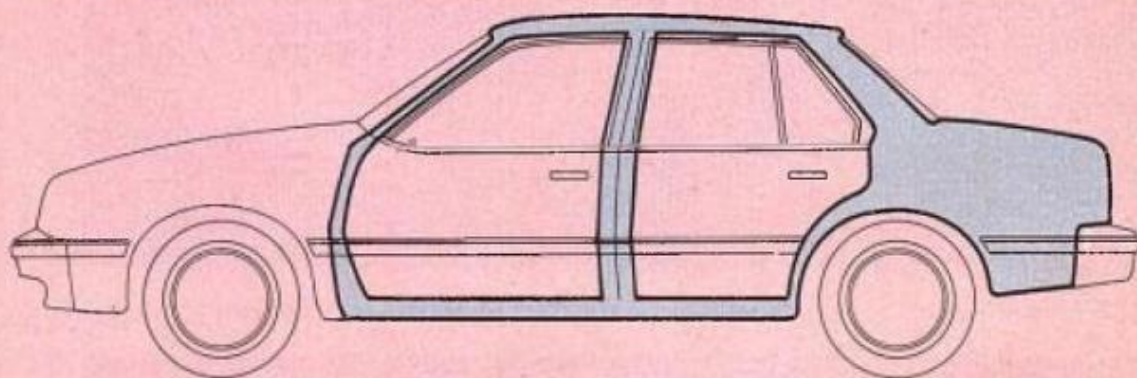
But this pushrod engine is state-of-the-art. It's a high-revving power plant (6,000 rpm redline) with performance that beats competitive overhead cammers. In fact, at 88 hp it produces more power per liter than any other GM engine in stock trim.

The reason for the pushrod design was simple enough: For the transverse-engine installation, it meant that an external belt drive needed to drive an overhead cam-

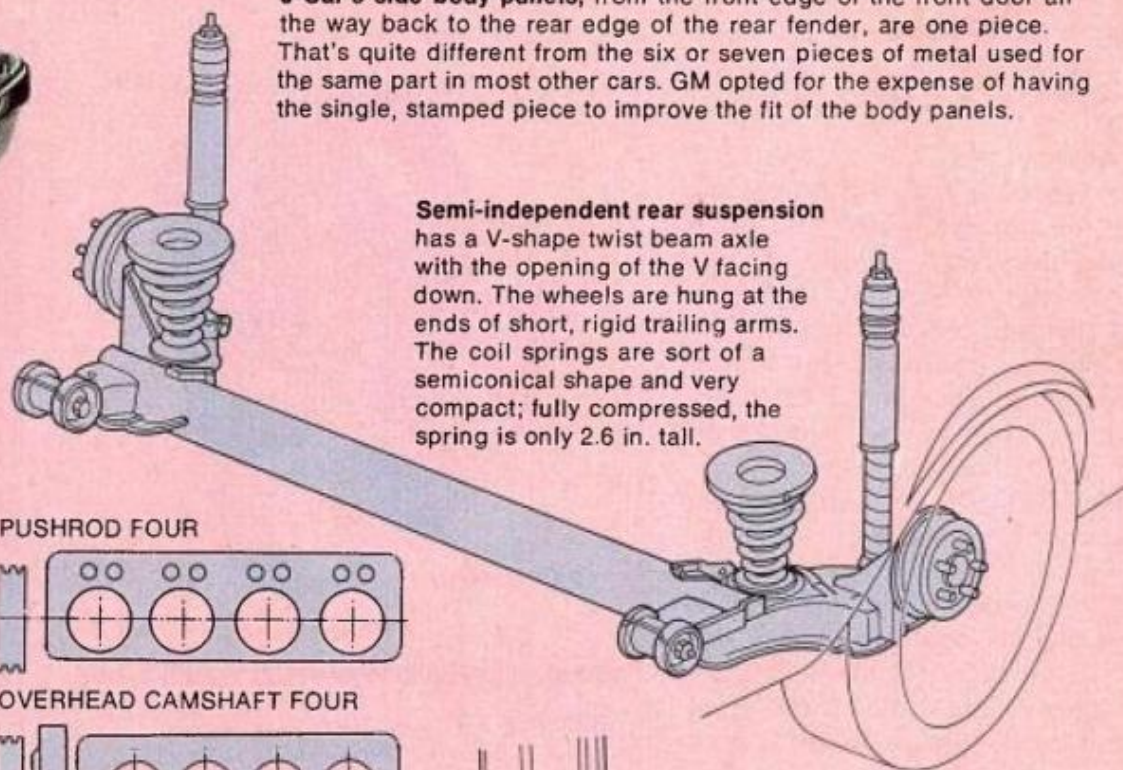
shaft could be eliminated, saving more than an inch in engine length. So the engine can have larger bores, which not only helps low-end breathing, but permits an eventual, theoretical displacement of as high as 2.2 liters. This is handy if you want it to be your Four of the future and cover all corporate applications. GM isn't totally giving up on overhead cams. In fact it will install a Brazilian-made OHC in the Pontiac J-Car next year to cover a capacity shortage on the pushrod mill.

To help the pushrod engine rev

J-Car's trunk volume is among the best in class. At 13.2 cubic feet, with rear seat up, it's almost as large as a Rabbit's—with the rear seat folded down.

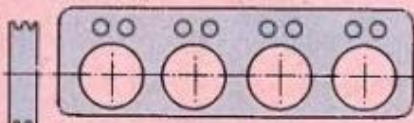


J-Car's side body panels, from the front edge of the front door all the way back to the rear edge of the rear fender, are one piece. That's quite different from the six or seven pieces of metal used for the same part in most other cars. GM opted for the expense of having the single, stamped piece to improve the fit of the body panels.

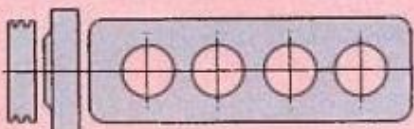


Semi-independent rear suspension has a V-shape twist beam axle with the opening of the V facing down. The wheels are hung at the ends of short, rigid trailing arms. The coil springs are sort of a semiconical shape and very compact; fully compressed, the spring is only 2.6 in. tall.

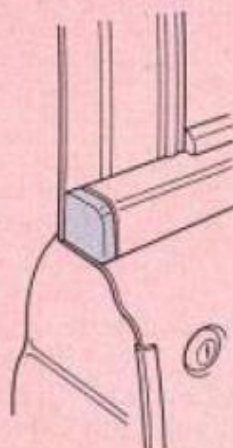
PUSHROD FOUR



OVERHEAD CAMSHAFT FOUR



With simple schematic above, you can see that by opting for a pushrod engine design, without the chain or belt drive needed for an overhead camshaft design, GM was able to develop a pushrod engine of the same overall size as an overhead cam, but with larger cylinder bores for more displacement.



Plastic caps on the ends of body molding strips instead of crimped closures are one GM attempt to improve the small-but-noticed details in a finished car's appearance.

The rear suspension is all-new and designed by Pontiac. Compact design has a V-beam rear axle, short, rigid trailing arms and compact, conelike coil springs.

The fuel tank is located ahead of the rear axle. This allows for a larger trunk as well as better rear-end impact protection than if the tank were behind the axle.